IB MYP YEAR 5

YEAR 10 Mathematics

Assessment #4

AP, GP, LOGARITHM, EXPONENTIAL, BEST FIT

Name: Cindy Cheng (10 Peace)

Teacher: **Ms. Li, Mr. So & Mr. Wong**

Date of task: **Friday, 22nd February, 2013** Time allowed: **2 lessons**

Student's **Performance** in Different **Criterion**			
A	7	**D**	4

INSTRUCTIONS:

Read the **rubric** carefully because that is how you will be graded.
Read the instructions for all questions carefully.
Show all work, steps and proper units.
Write your answers on the lined paper/graph paper provided.
GDCs are allowed.
Ask the teacher for scrap paper, but any work on the scrap paper will **NOT** be marked.
Allowed to use calculators.
Allowed to use **non-electronic dictionary**.

Criterion A: KNOWLEDGE AND UNDERSTANDING

Achievement level	Task Specific Rubric	IBO Published Descriptor	Student's self-evaluation
0	The student does not reach a standard described by any of the descriptors given below.	The student does not reach a standard described by any of the descriptors given below.	
1–2 Simple	The student manipulates the data correctly, but **without** reaching a full model.	The student **generally** makes appropriate deductions when solving **simple** problems in **familiar** contexts.	**(0-8)**
3–4 Complex	The student is able to come up with a **basic** model and make simple **predictions** based on the model.	The student **generally** makes appropriate deductions when solving **more complex** problems in **familiar** contexts.	**Teacher's Final Grade**
5–6 Challenging	The student is able to come up with an **appropriate** model and **explain** the processes by which the model was created.	The student **generally** makes **appropriate** deductions when solving **challenging** problems in a **variety** of **familiar** contexts.	
7–8 Unfamiliar	The student comes up with an appropriate model which fits the initial data and then comes up with an **unfamiliar model** which also fits the **new data**.	The student **consistently** makes **appropriate** deductions when solving **challenging** problems in a **variety** of contexts including **unfamiliar** situations.	**(0-8)**

Criterion D: REFLECTIONS & EVALUATIONS

Achievement level	Task Specific Rubric	IBO Published Descriptor	Student's self-evaluation
0	The student does not submit a poster. Or, the students submit work with unacceptable quality.	The student does not reach a standard described by any of the descriptors given below.	
1–2 Real Life	Student talks about real life changes in Hong Kong which cause changes in the growth of rubbish.	The student **attempts to explain** whether his or her results make sense in the context of the problem. The student **attempts to describe** the importance of his or her findings in connection to real life.	**(0-6)**
3–4 Degree of Accuracy	In considering the percentage error, student can justify which model is more accurate in predicting waste in 2009-11. Percentage error must be attempted to achieve a level 4.	The student **correctly but briefly explains** whether his or her results make sense in the context of the problem. The student **describes the importance** of his or her findings in connection to real life where appropriate. The student **attempts to justify** the degree of accuracy of his or her results where appropriate.	**Teacher's Final Grade**
5–6 Improve-ments	Student thinks critically about units and the improvements of the second model from the first model. Percentage error is used to catch mistakes if any.	The student **critically explains** whether his or her results make sense in the context of the problem. The student provides a **detailed explanation** of the importance of his or her findings in connection to real life. The student **justifies the degree of accuracy** of his or her results where appropriate. The student suggests improvements to his or her method where appropriate.	**(0-6)**

HOW DOES TRASH IN THE TKO LANDFILL GROW?

The government proposes expanding the Tsang Kwan O landfill (opened at the start of 2000). You have gathered the following data:

Year	2001	2002	2003	2004	2005	2006	2007	2008
m^3/day	1,749	1,903	2,040	2,274	2,549	2,645	2,811	2,940

Table 1: Commercial & Industrial Solid Waste in Hong Kong[1]

You suspect there is a predictable pattern in the growth of waste dumped at the site.

1. **Find** a mathematical model that appropriately describes the growth. **Explain** the processes by which the model is created?

Average:

AP	X	154	137	234	275	96	166	129	170.14
GP	X	1.09	1.07	1.11	1.12	1.04	1.06	1.05	1.077

$T_n = 1749+(n-1)170.14$ $\quad T_n = 1749 \times 1.077^{n-1}$

$=1749+170.14n-170.14$

$=1578.9+170.14n$

AP	1749	1919.2	2088.4	2259.46	2429.6	2599.7	2769.9	2940 ✓
GP	1749	1883.7	2028.7	2184.9	2353.2	2534.4	2729.5	2939.7

% error

Ave:

AP	X	-0.85%	-2.37%	0.64%	4.68%	1.71%	1.46%	0%	0.75% ✓
GP	X	1.01%	0.55%	3.92%	-3.48%	7.68%	2.9%	0.01%	1.38%

The percentage error of AP model is less than GP model, therefore the AP model more appropriately describes the growth.

1 The Government of the Hong Kong Special Administrative Region, "Monitoring of Solid Waste in Hong Kong," Disposal of Solid Waste at Landfills: Commercial & Industrial Waste (plate 2.3), 2000-2010, viewed January 13, 2013, http://www.wastereduction.gov.hk/en_html/assistancewizard/waste_red_sat.htm

2. By using the model you acquired, predict which year the amount of waste will be **more than 3200 m^3/day**.

$1749 + (n-1)170.14 > 3200$

$1749 + 170.14n - 170.14 > 3200$

$170.14n + 1578.86 > 3200$

$170.14n > 1621.14$

$n > 9.5$

In 2010, the amount of waste will be more than 3200 m^3/day.

3. Predict the amount of waste OVER THE ENTIRE YEAR dumped in **2009**, **2010** and **2011** based on your model.

2009:

$1749 + (9-1)170.14$

$= 1749 + 1361.12$

$= 3110.12\ m^3/day$

$3110.12 \times 365 = 1,135,193.8\ m^3$

2010:

$1749 + (10-1)170.14$

$= 1749 + 1531.26$

$= 3280.3\ m^3/day$

$3280.3 \times 365 = 1,197,309.5\ m^3$

2011:

$1749 + (11-1)170.14$

$= 1749 + 1701.4$

$= 3450.4 \text{ m}^3/\text{day}$ ✓

$3450.4 \times 365 = 1,259,396 \text{ m}^3$ ✓

4. The actual amount of waste dumped in 2009, 2010 and 2011 were 1,089,160 m^3/year, 1,087,335 m^3/year and 1,103,395 m^3/year. Using **percentage errors** or any other valid method, come up with the degree of accuracy of your predictions in question 3. **How accurate was your model?**

2009:

$$\frac{1089160 - 1135193.8}{1089160} \times 100\%$$

$= -4.23\%$ ✗

2010:

$$\frac{1087335 - 1197309.5}{1087335} \times 100\%$$

$= -10.1\%$ ✗

2011:

$$\frac{1103395 - 1259396}{1103395} \times 100\%$$

$= -14.1\%$ ✗

My model was actually quite accurate, as the largest percentage error in 2011 was still only -14.1%, which means my model predicted slightly higher than the actual amount.

5. What changes in **Hong Kong in 2009** could account for any change in the pattern of waste growth?

Hong Kong in 2009 might be when recycling was openly suggested to the citizens of Hong Kong, and people began to reuse, things, throw thing in recycle bin for recycling the waste into new useful things and reducing waste produced. Therefore as the recycling scheme was opened, waste produced reduced, and so there was a change in the pattern of waste growth.

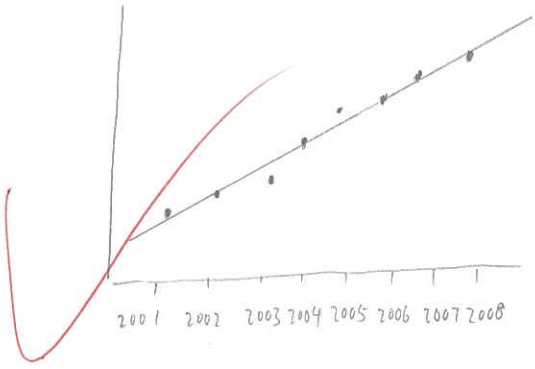
6. Use your calculator to come up with a **new** model (not linear or exponential). Write down the model below.

log

$y = a + b \times \ln x$

$a = -2.713 \times 10^6$

$b = 357166.111$



$a + b \times \ln 8$

$= a + 742706.05$

$= -1970293.95$

$-1970293.95 \div 365$

$= -5398.1$

$$\frac{2940 - (-5398.1)}{2940} \times 100\%$$

$= 283.6\%$

7. Use **both** your **original** and **new** models to predict the amount of waste generated in **2013**.

Original:

$1749 + (13-1)\,170.14$

$= 1749 + 2041.68$

$= 3790.68\ m^3/day$

$3790.68 \times 365 = 1383598.2\ m^3$

New:

$-2.713 \times 10^6 + 357166.1 \times 13$

$= -2.713 \times 10^6 + 916112.9869$

$= -1796887\ m^3$

8. How do the results in Q7 compare? Explain the differences in your results. Why are they important?

There is quite a huge difference in the results of my original and new model. The original model result is more reliable than the new model, because as I calculated the percentage error in question 6, the error is 283.6%, which means it is far away from the actual data. Whereas the origanal model percentage error is only 0.75%. The difference show that the data is not suitable for log, because the data calculated from the new model is not accurate.

THE END